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DEPARTMENT OF COMMERCE
BUREAU OF STANDARDS
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GENERAL NOTE.

Owing to the current nature of the investigations mentioned in the Technical News Bulletin, sometimes it will be impossible to supply printed information regarding them. However, in these cases, when the investigation has progressed sufficiently far, the Bureau will be pleased to furnish technical data to those engaged in the particular application of the subject, in order to avoid the delay incident to publication.

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1. Refrigeration Constants

For a number of years the Bureau has been conducting researches on the determination of the thermal properties of materials, so far principally the media used in the production of artificial refrigeration.

This work has involved, first, the procuring of the fixed equipment required; second, the selection and training of a staff of investigators who were capable of carrying out the refined physical measurements; third, the development of methods of measurement suitable for the considerable range of temperatures and pressures involved and the construction, testing, and installation of the special apparatus required; fourth, making the measurements and preparing the results for publication in scientific papers, and making the results available for use by tabulating them in the forms required in engineering practice.

The work so far completed dealswith the specific heats of brines, the specific and latent heats of ice, and the specific heat, latent heat, and vapor pressure of ammonia, and with heat transmission through insulating materials and structures. The work completed on ammonia serves as the basis of a complete table of thermodynamic properties of the liquid and saturated vapor, for use in refrigerating engineering. Work on the properties of superheated ammonia vapor is under way and should within the year yield data to complete the tables of properties

of ammonia. These tables will be the equal, if not the superior, in point of accuracy, of existing data on the properties of steam. The methods and apparatus developed during the work on ammonia are available and should be used to measure the properties of other media now being used in refrigeration.

When we consider that existing tables are based largely on the work of Regnault done 50 or 60 years ago, it is obvious that systematic measurements of this kind should be made with modern facilities.

It should be pointed out that the work which has been completed thus far is of enduring scientific and engineering value. The best available modern instruments of precision measurement have been utilized, the accuracy that has been attained is high, and the results have been checked in every instance by independent methods of experimentation and often by entirely different experimental equipment and by different observers.

Of the several steps involved in such a program and enumerated above, the first three are largely completed. The present program contemplates extending the work to the determination of the properties of materials other than ammonia, thus utilizing efficiently specialized experience and equipment which has been accumulated. Materials on which work is contemplated include carbon-dioxide, ethyl and methyl chlorides, and perhaps sulphur dioxides.

2. Pyroxylin Plastics

The changes in weight with changes in relative humidity of the surrounding atmosphere have been under investigation for many months, as part of the general investigation conducted through cooperation of various sections of the Bureau. Samples from three different makers and of thicknesses from 0.01 inch to nearly 0.05 inch were used.

For several months all samples showed an appreciable loss with age in addition to whatever loss or gain was caused by changes in humidity, but on the samples used this effect of age was relatively small and could be neglected perhaps because the samples were at least several months old before the humidity measurements were begun.

The changes in humidity did not produce permanent changes in weight - the weight rising and falling with the humidity, no matter how often it was changed.

There were no appreciable differences between the results shown by samples from different makers, nor between those listed as "transparent", "ivory", "cream", and "red".

The changes with humidity are not merely surface effects. When the humidity was changed by 20 to 40%, the

small samples changed in weight quickly and came to equilibrium in a week or two; but in some cases the thicker samples were still gaining rapidly after two months.

Beginning with a high humidity, the change in weight is greater than it would be for the same change made from a lower humidity. For example, the samples tested showed an increase of 1% for an increase of 15% relative humidity in the neighborhood of 80% and approximately the same amount (1%) for an increase of 30% in the neighborhood of 40% relative humidity.

3. Test of Railroad Track Scale for the Navy Department

Recently the Bureau tested a new railroad track scale for the Navy. This test was carried out in the scientific manner which has been adopted as standard by the Bureau. As is usually the case in newly installed scales, errors were found in the sections of the scale. It has been generally held by many scale men that it is not practical to apply theory very directly to the correction of errors in the sections of railroad track scales, and adjustments are necessarily made by using the method of trial and error.

After the errors were determined in the scale under test, the movement of the nose irons required to correct them was computed on a theoretical basis and carried out. The adjustment of the nose irons was expedited by the fact that in accordance with the specifications adopted for track scales by the Bureau of Standards the manufacturer had equipped the nose irons with a screw-drive by means of which they could be changed precisely any amount desired.

On retesting the scale after the adjustments were completed, it was found practically without error. Moreover, the skillful manner in which the adjustments were carried out enabled the corrections to be made in a surprisingly short time, much shorter than would have been possible in attempting to secure results by the old method of trial and error. A representative of a scale manufacturer present at the test was very much impressed by the efficiency of the method.

4. White Coat Cast Iron Enamel

Enamels of this sort are largely used by stove manufacturers and the chipping off of the enamel has been a serious problem in this class of work. The Bureau is conducting an investigation of the subject and during the past month nine ground coats have been prepared and applied to a number of cast iron samples. It was found that smelting some of the composition by the frit-crucible method gave unsatisfactory results because of the chipping of the ground coat when applied to the iron. Duplicate

mixes were, therefore, prepared by fritting in the kiln at lower temperatures and the preliminary results would indicate that this method is preferable. The comparative tests are being continued and it is believed that considerable information will be gained regarding the effect of various methods of smelting which will form an important part of the investigation. Ground coats which previously have given trouble from blistering with more or less refractory cover coats are working satisfactorily with cover coats of a more fusible nature. It appears, therefore, that it will be necessary to develop a number of typical fusible ground coats to be used in connection with the softer cover coats which is desired by certain of the stove manufacturers.

5. Discoloration of Indiana Limestone

In order to eliminate the brown stains which frequently appear on new limestone masonry and which are thought to be due to the mortar, tests have been started to determine the effect of using colorless waterproofing materials on the limestone at points where it comes in contact with the mortar. The indications are that if water can be prevented from leeching through the mortar and entering the limestone that stains will not occur. The tests indicate that the greater part of the stain can be prevented by this means.

Another method of eliminating the stains, which is being tried, consists of coating the exposed face of the limestone walls as they are built with a porous coat that can be readily removed. The stains come through the coat and form on the outer surface and by removing the coat the stain is removed also. The insoluble nature of the material which forms the stain makes it very difficult to remove from the limestone, but by allowing it to form on the coating, as mentioned above, it can be readily removed. Since most of these stains form during the erection of the masonry, the method may prove of some value.

6. Study of Test Methods for Developing Standard Specifications for Paper Bags used in Connection with Cement and Lime

Technologic Paper No. 187 of the Bureau of Standards has lately been published on this subject and is for sale by the Superintendent of Documents at 5¢ a copy.

The object of the paper is to aid the manufacturers of paper bags in meeting the requirements of the cement and lime industries, particularly in the matter of obtaining a suitable paper for the shipment of these products. It contains information relating to the methods of testing and the apparatus employed in determining the quality of these bags. Samples are obtained from the manufacturers and are suitably identified. They are then subjected to

two classes of tests, known as ordinary and special tests. The first class consists of the usual tests for paper, while in the second class, tests are employed which are specially appropriate for paper bags.

These include laboratory tests for recording the stresses and strains which the paper undergoes in service, tests to determine the breaking strength when the bag is filled with sand, and tests to determine the strength of the adhesive used in the bags.

The results of all these tests are tabulated and from the data thus secured the best quality of bags is chosen. As a result of this work, specifications have been written covering all the qualifications of satisfactory bags for this service.

7. New Chemical Publications

"The Determination of Iron by the Cupferron Method" by G. E. F. Lundell. Journal of the American Chemical Society, Vol. 43, page 487. This paper was prepared to controvert certain recently published statements.

Summary. (1) The precipitation of iron by cupferron is quantitative in hydrochloric or sulphuric acid solutions containing as much as 20% by volume of either acid. (2) The cupferron precipitate of iron is not soluble in cold dilute hydrochloric acid (1:9) wash water. (3) Ammoniacal wash waters, which need be rarely employed, may cause losses. These are always indicated by the formation of turbid filtrates. (4) Crystal clear filtrates and washings are absolutely essential in accurate determinations of iron by the cupferron method. (5) Cupferron precipitates of iron occasionally exhibit the annoying tendency of creeping through the filter. Consequently, when the filtrate or wash water is even opalescent, the need of such corrective treatment, as refiltration or digestion in the cold followed by refiltration is indicated.

8. Artificial Iron Ore for Use in Hydrogen Production

An "artificial iron ore" has been developed for use in the steam-iron process of hydrogen generation. This material is made by impregnating a porous earthenware supporting body of approximate shape with iron nitrate and decomposing it to the oxide. Laboratory experiments on a limited scale indicate that this material is far superior to a natural iron ore for the purpose of producing hydrogen. The Bureau is about to undertake the production of a sufficient amount of this material to permit of extensive tests in the hydrogen plant at Langley Field.

9. Non-Ferrous Etching Reagents

An interesting development in connection with the etching of nickel and its alloys is the use of concentrated hydrochloric acid. This appears to be the best reagent for producing contrast without pitting of the surface that has yet been tried. It is rather hard to etch nickel and ordinarily the metal pits considerably and a plain etched pattern, that is, one in which there is no contrast between different grains, is the usual result. Etching in concentrated hydrochloric acid for a considerable period, say one hour or more, gives very satisfactory results.

10. Effect of Rolling Conditions on Properties of a Medium Carbon Steel

This investigation is now practically completed and the results to date show that the mechanical properties of the steel are changed but little by a wide variety of rolling conditions. The difference in properties between transverse and longitudinal specimens from the same plate is as great or greater than any variation in similar specimens produced under different rolling conditions.

11. Corrosion of Sheet Duralumin

An inspection has been made of corroded duralumin in the form of thin sheets used in the construction of all metal airplanes. The material became brittle in service owing to the development of intercrystalline "cracks" evidently as a result of corrosion. The attempt was made to produce the brittle condition in portions of the sheet which apparently were still ductile. By corrosion alone as well as by the simultaneous action of corrosion and stress, it was possible to develop intercrystalline brittleness in the specimens. Annealing of the material, annealing followed by slight cold rolling and severe cold rolling of the commercial stock did not appear to affect materially the corrosion. In this case it appears certain that the deterioration was the result of the corrosion of the sheet. Brittleness developed because of corrosion from both acid and neutral solutions but an alkaline attack did not appear to cause the development of brittleness.

12. Meeting of the Advisory Committee on Non-Ferrous Alloys

The semi-annual meeting of the Advisory Committee on Non-Ferrous Alloys was held at the Bureau on April 20 and was well attended by members of the non-ferrous industries, representatives of the several interested technical societies, and also by representatives from the technical services of the War and Navy Departments. Among the subjects discussed were specifications for hard drawn brass wire for use in connection with the release mechanism of airplane bombs, rotating bands for projectiles, various aircraft problems related to aluminum alloys, bearing metals, the role

of gases in metals, and the corrosion and etching of metals.

The Committee considered the corrosion problem of the greatest economic importance and thought it desirable to form a joint committee, the organization of which would resemble that of the Joint Committee on the Effect of Sulphur and Phosphorus in Steel, and the Secretary, Mr. Corse, was requested to raise the question at the forthcoming meeting of the Division of Research Extension of the National Research Council.

13. Strength Tests of Ideal Walls

An investigation has been started to determine the compressive strength of Ideal brick walls in cooperation with the Common Brick Manufacturers Association of America. The Ideal walls are laid with common brick but in such a manner as to include an air space in the wall and still be well tied together. There is a considerable saving in the number of bricks, the amount of mortar and the time required to lay these walls over the ordinary solid walls. It is also claimed that one can plaster directly on these walls thus avoiding the expense of studding, lath, etc. The present schedule calls for the erection of three Ideal walls and two solid ones for comparison. Four of the walls have already been built and will be tested as soon as they are 30 days old. Considerable preliminary work, such as gage calibration and the testing of individual bricks has already been done.

14. Meeting of Executive Committee of the American Engineering Standards Committee

A meeting of the Executive Committee of the American Engineering Standards Committee, the headquarters of which are at 29 W. 39th Street, New York City, was held at the Bureau of Standards at 10 o'clock on Friday, April 8.

The object of the meeting was to discuss the possibility of securing government support for the valuable work which this committee has in hand. Representatives of the War, Navy, Agriculture, Interior, and Commerce Departments were present, as well as representatives from the various engineering societies holding memberships in the committee.

15. Committee Meeting on Revision of Tire Specifications

On April 8, a meeting was held at the Bureau of Standards for the purpose of discussing government tire specifications. The Motor Transport Corps, as a very large user of automobile tires, is particularly interested in this problem, and they assisted by sending announcements of the meeting to various tire manufacturers. Representatives of the different companies were particularly requested to be present and in addition the government was represented as follows: War, Navy, Treasury, Agriculture, Interior, Commerce, and Post Office Departments, the Panama Canal, Shipping Board, Compensation Commission, and the Commissioners of the District of Columbia.

At the meeting ways and means for revising government tire specifications with the view to adopting better standards were discussed. Specifications for tires which the Bureau had prepared were submitted to the committee for discussion and the various members suggested such changes as seemed desirable. The committee decided to send a copy of the specifications, together with these recommended changes, to the Rubber Association of America for their consideration and possible further revision. The specifications and the resulting changes are then to be returned to the Bureau of Standards when a second meeting will be called for further consideration of the problem. When completed, these specifications for tires will be available to the various branches of the government, to municipalities, and to private corporations who buy tires in quantity.

16. Meeting of Screw Thread Commission

The National Screw Thread Commission met at the Bureau of Standards on Monday, April 18, and considered the Progress Report recently issued, and outlined a program for continuing the work of the Commission.

The following program was agreed upon and will be carried out under the direction of sub-committees:

(1) Specifications and tolerances for taps, dies, and tap drills; (2) Standardization of bar stock for producing cut and rolled threads; (3) Standardization of bolt heads, screw heads, and nuts; (4) Standardization of instrument thread and threads cut on brass tubing; (5) Standardization of Acme, square, buttress, and other special threads, and (6) Tolerances and allowances for Class IV, wrench fit.

The Progress Report is also to be further studied with a view to incorporating in it more information as to the specific class of fit and series of thread pitches to be used under different conditions.

17. Looking Into the Cylinder of a Gasoline Engine in Operation

The first tool used by the investigator is usually the eye. He sees a thing happen and the first step in his investigation is likely to be the obtaining of a telescope, microscope or something to enable him to see more clearly.

In the development of the internal combustion engine, however, visual observation of the combustion has played a minor role. To be sure, early investigators did provide apparatus that permitted them to look in the cylinder while the engine was operating, but little has been done in this direction with engines operating at the high speeds of the present day automobile types. Interest has centered in what an engine could do rather than how it did it. As a result, measurements of brake horsepower and fuel consumption have been deemed of first importance.

At the present time, the cry for fuel conservation has reawakened interest in the nature of the combustion in the cylinder. Glass induction systems have disclosed how satisfactorily, more often how unsatisfactorily, the fuel has been prepared for combustion. Analyses of the exhaust gases have shown how completely, more often how incompletely the charge has been burned. Admitting that it is important to study the preparation of the fuel for combustion and the results which are evident after it has taken place, an actual study of conditions during combustion should surely be worth while.

This has been accomplished in connection with the study of combustion in the one-cylinder Liberty engine at the Bureau of Standards in the following manner: A spark plug shell has been adapted to receive a circular section of glass intended to serve as a window in the cylinder. This assembly can be used in place of either spark plug in the ordinary aviation cylinder, but in this instance an additional boss has been welded to the cylinder in order that conditions might be observed with both plugs firing. Its use was satisfactory in that changes in flame color due to changes in air-fuel ratio were easily discovered. Since the entire combustion stroke is completed in one-sixteenth of a second at an engine speed of 1800 r.p.m., it is possible to see only the predominant color of the cycle by this means.

To make it possible to observe the combustion in its various stages, another device, a stroboscopic disk, was added. Its purpose is to permit the combustion to be observed only a small portion of the stroke. Since there is one power stroke for every two revolutions of the crankshaft, this disk is driven at one-half crankshaft speed. The flame is observed through a slot in the disk, the length of the slot governing the length of the portion

of the stroke studied. Provision is made for altering the angular relation of this slot to the crankshaft so that any interval of the cycle and, hence, any stage of combustion can be studied.

Observations made possible by this apparatus are not likely to replace any of the more usual measurements. They may, however, prove, and in fact have proved of considerable value in research work of the nature described by permitting observations of the duration of luminous flame during the power stroke, the characteristic differences in color and brightness at different phases of combustion and their variation with changes in ignition timing, mixture ratio, compression pressure, etc. One observes, for instance, excessively bright flashes of flame of extremely short duration accompanying the phenomenon known as fuel knock or detonation. The cause for this phenomenon is, of course, not revealed by usual observation.

Respectfully,

S. W. STRATTON

Director
HGB